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ARMY MOBILITY EQUIPMENT RESEARCH AND DEVELOPMENT COMM--ETC F/G 13/6
TRACTOR, WHEELED WAREHOUSE, GASOLINE, 4000-POUND-DRAWBAR-PULL, --ETC(U)
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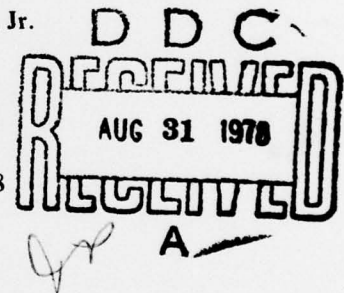
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Report 2239

TRACTOR, WHEELED, WAREHOUSE, GASOLINE,
4000-POUND-DRAWBAR-PULL, PNEUMATIC-TIRE -
MANUFACTURER SURVEY

by
James E. Stephens, Jr.
and
Jesse W. Reid, Jr.

March 1978



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U.S. ARMY MOBILITY EQUIPMENT
RESEARCH AND DEVELOPMENT COMMAND
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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER 2239	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) TRACTOR, WHEELED, WAREHOUSE, GASOLINE, 4000-POUND-DRAWBAR-PULL, PNEUMATIC-TIRE - MANUFACTURER SURVEY		5. TYPE OF REPORT & PERIOD COVERED
7. AUTHOR(s) James E. Stephens, Jr. Jesse W. Reid, Jr.		6. PERFORMING ORG. REPORT NUMBER
9. PERFORMING ORGANIZATION NAME AND ADDRESS Mechanical and Construction Equip Lab, DRDME-HM US Army Mobility Equipment Research and Development Command, Fort Belvoir, Virginia 22060		8. CONTRACT OR GRANT NUMBER(s)
11. CONTROLLING OFFICE NAME AND ADDRESS Commander US Army Mobility Equipment Research and Development Command, Fort Belvoir, Virginia 22060		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		12. REPORT DATE Mar 78
		13. NUMBER OF PAGES 34 12 30p.
		15. SECURITY CLASS. (of this report) UNCLASSIFIED
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited.		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Material-Handling Equipment Reliability, Availability, and Maintainability Warehouse Tractor Quality Assurance Gasoline Engine Specification Pneumatic Tire Procurement Maintenance		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report is the result of emphasis on procuring commercial warehouse tractors in lieu of Military Adaptation of Commercial Items (MACI). To satisfy the prerequisites for procuring/fielding commercial material-handling equipment, MERADCOM implemented a seven-phase program. This report presents the results from the first two phases.		

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Four manufacturers of warehouse tractors were visited by a Survey Team using a Manufacturer Survey Questionnaire (Technical Information Package (TIP)). Each manufacturer proposed a model which should satisfy the item description used in conjunction with the TIP.

Results from the survey include a candidate make and model list for commercial warehouse tractors. The results also support this general conclusion: Commercial warehouse tractors do not differ significantly from warehouse tractors previously procured by the Army using MACI specifications.

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METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
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LENGTH

in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km

AREA

in ²	square inches	6.5	square centimeters	cm ²
ft ²	square feet	0.09	square meters	m ²
yd ²	square yards	0.8	square meters	m ²
mi ²	square miles	2.6	square kilometers	km ²
	acres	0.4	hectares	ha

MASS (weight)

oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	metric tons	t

VOLUME

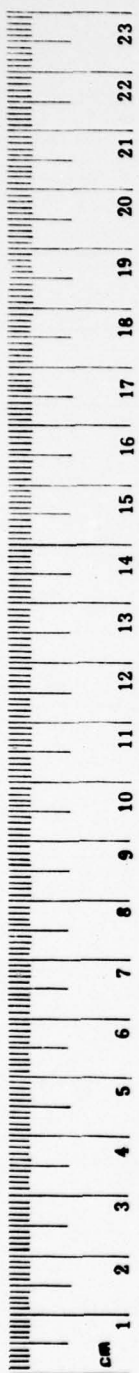
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	L
pt	pints	0.47	liters	L
qt	quarts	0.95	liters	L
gal	gallons	3.8	liters	L
ft ³	cubic feet	0.03	cubic meters	m ³
yd ³	cubic yards	0.76	cubic meters	m ³

TEMPERATURE (exact)

°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C
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* 1 in = 2.54 cm (exactly).





Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
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LENGTH

mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi

AREA

cm ²	square centimeters	0.16	square inches	in ²
m ²	square meters	1.2	square yards	yd ²
km ²	square kilometers	0.4	square miles	mi ²
ha	hectares (10 000 m ²)	2.5	acres	

MASS (weight)

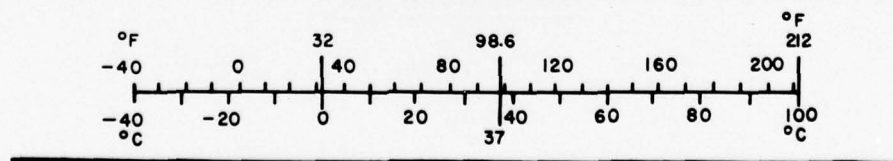
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	metric tons (1000 kg)	1.1	short tons	

VOLUME

ml	milliliters	0.03	fluid ounces	fl oz
L	liters	2.1	pints	pt
L	liters	1.06	quarts	qt
L	liters	0.26	gallons	gal
m ³	cubic meters	35	cubic feet	ft ³
m ³	cubic meters	1.3	cubic yards	yd ³

TEMPERATURE (exact)

°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F
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**TRACTOR, WHEELED, WAREHOUSE, GASOLINE,
4000-POUND-DRAWBAR-PULL, PNEUMATIC-TIRE -
MANUFACTURER SURVEY**

I. INTRODUCTION

1. **Background.** On 24 May 1976, the Office of Management and Budget directed the Government to emphasize the acquisition of commercial, off-the-shelf products in order to achieve optimal effectiveness in supply support operations. The resulting emphasis on procurement of commercial products included the warehouse tractor. Therefore, MERADCOM initiated a program to develop a procurement whereby commercial, off-the-shelf warehouse tractors could be procured and supported. An outline of this program for the warehouse tractor included the following elements:

- a. Prepare the Manufacturer Survey Questionnaire.
- b. Conduct and report the Manufacturers Survey.
- c. Prepare the User Survey Questionnaire.
- d. Conduct and report the Users Survey.
- e. Develop the procurement specification.
- f. Procure commercial warehouse tractors.
- g. Type classify.

2. **Objective.** This report presents the results of a survey of four manufacturers of commercial warehouse tractors: Clark, Northwestern, Pettibone, and United.

3. **Descriptions of Warehouse Tractor.** Heretofore, Military adaptations of commercial warehouse tractors have been procured using Military Specification MIL-T-52852 (a tow tractor procured using MIL-T-52852 is shown in Figure 1). This specification, in turn, was assumed to represent the requirement baseline for commercially available warehouse tractors. These commercial warehouse tractors can be described as follows:

<u>Characteristic</u>	<u>Requirement</u>
Drawbar pull	4000 lb (minimum)
Engine type	Gasoline
Transmission	Automatic
Number of speeds forward	2 (minimum)

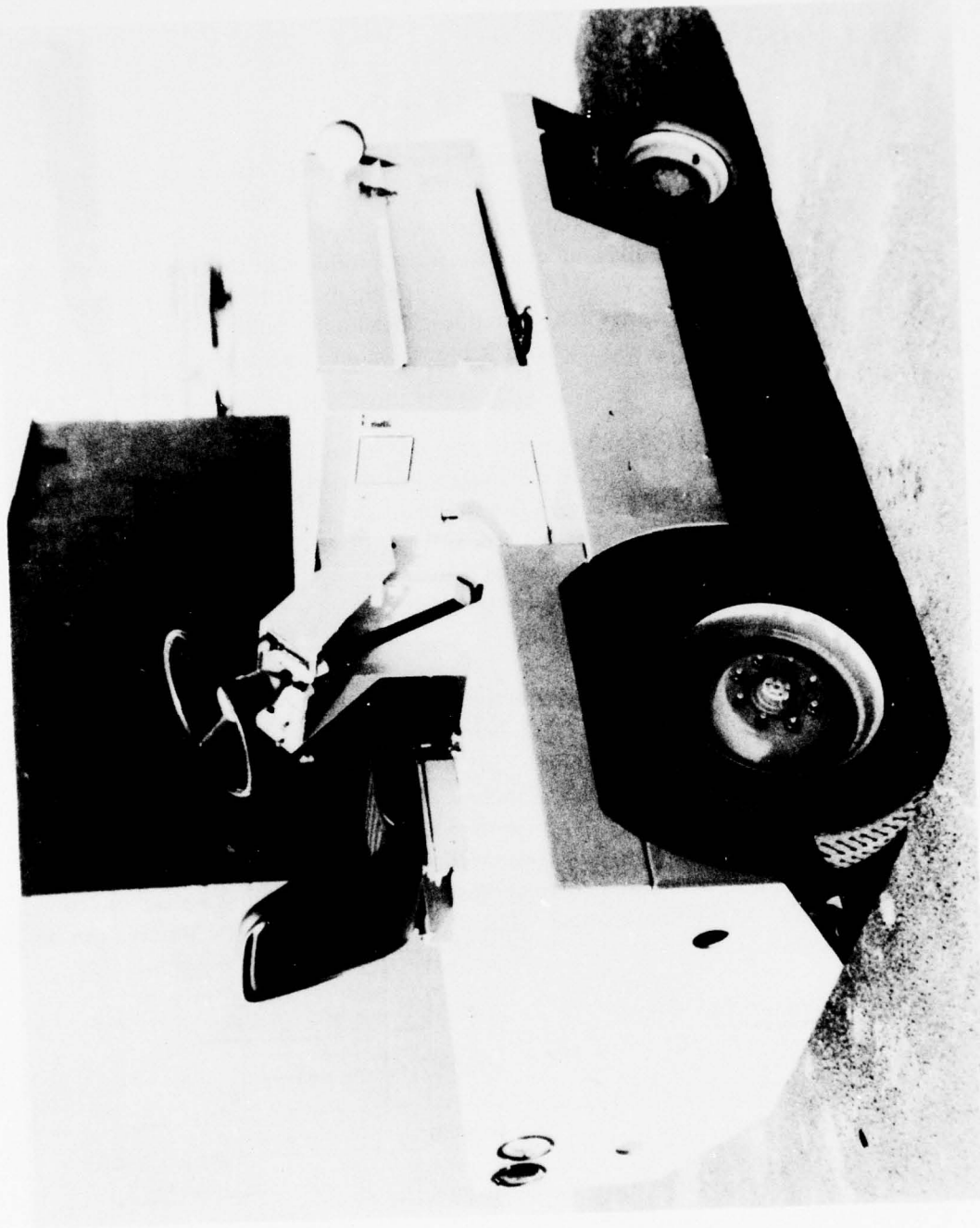


Figure 1. Warehouse tractor purchased via MIL-T-52852

Number of speeds rearward	1
Speed	12 mi/h (minimum)
Tires: Number	4
Type	Pneumatic
Maneuverability	90° turns from and into intersecting 90-inch-wide aisles.
Temperature range in which vehicle must operate	0° to 110° F
Typical use	In general warehouses and depots pulling trailer trains, and at airfields towing aircraft.

4. **Scope.** This report considers this program's two initial elements:

- a. Preparing the Manufacturer Survey Questionnaire.
- b. Conducting and reporting the Manufacturer Survey.

II. SURVEY OF MANUFACTURERS

5. **Baseline Description of Warehouse Tractor.** The manufacturer questionnaire was designed as a "dry run" of the first step of two-step procurement. Therefore, a baseline description was necessary to ensure that each manufacturer would respond to the identical baseline. The warehouse tractor description presented in paragraph 3 was expanded into a narrative format to include the Army's requirements and to encompass commercially available warehouse tractors. This description is presented in the Appendix to this report.

6. **Preparation of the Manufacturer Survey Questionnaire.** MERADCOM developed a survey questionnaire for use in the Commercial Equipment Program and for eventual use in two-step procurement of warehouse tractors. As the first procurement step, the manufacturer uses the questionnaire to describe his product. The Government then evaluates the manufacturer's response to ensure that it represents the manufacturer's commercial product and satisfies the Contract Specification. Part of the Government's evaluation includes input from a survey of commercial users of these warehouse tractors. The manufacturers judged to be responsive are then requested, as the second procurement step, to submit competitive bids on their response/descriptions. Finally, the Government uses the information presented by the manufacturers in step one to accept or reject the warehouse tractors when they are inspected for acceptance by the Government.

The Manufacturer Survey Questionnaire was coordinated with interested agencies including TARCOM and DARCOM Packaging, Storage, and Containerization Center (User Representative). The questionnaire was developed to solicit the following from the manufacturer:

- a. Candidate model.
- b. Standard equipment list.
- c. Optional equipment list.
- d. Major component specification/manufacturer/part number.
- e. Logistical/maintenance data.
- f. Commercial user list.

The resulting questionnaire was designated the Technical Information Package (TIP) for the warehouse tractor. Each manufacturer was requested to complete the TIP for his tow tractor which corresponds to the previously discussed item description.

7. **Selection of the Manufacturers.** The following criteria were developed to identify manufacturers of tow tractors which match the Army's requirements: "The manufacturer shall produce a standard warehouse tractor which corresponds to the item description. Furthermore, the manufacturer shall have marketed the standard tractor in significant quantities to the Government and/or commercial users for at least 1 year. However, the introduction of normal product improvement changes in this 1-year period is acceptable." These criteria, except for one change, are similar to those used in other Commercial Equipment Programs. "Supplying warehouse tractors to the Government" was added as a qualifier; otherwise, two manufacturers, Northwestern and United, would have been excluded because their commercial markets are relatively small. Four U.S. manufacturers (Clark, Pettibone, United, and Northwestern) were identified as survey candidates whose tractors met these criteria.

III. RESULTS OF SURVEY OF MANUFACTURERS

8. **Visits to Manufacturers.** The four manufacturers of commercial warehouse tractors identified above were visited by a survey team composed of a member from MERADCOM and TARCOM's Quality Assurance and Maintenance Directorates. The survey team explained the Commercial Equipment Program and stressed the point that commercial warehouse tractors would be procured only if they satisfied the Army's requirement. Each manufacturer was cooperative and fulfilled MERADCOM's request to submit a completed TIP to MERADCOM.

9. **TIP Evaluation.** Prior to a discussion of the results contained in the Technical Information Packages, it is appropriate to present the findings of the visits to the manufacturers. The manufacturers were equally divided for and against endorsing the

Commercial Equipment Program concept. All manufacturers use Quality Assurance Procedures which satisfy the requirements of Military Specification MIL-I-45208. Each manufacturer provided a maintenance manual to the survey team member from TARCOM Maintenance Directorate. Commercial Logistical Support and Warranties were discussed. Three manufacturers provide logistical support and warranty service through their local dealer networks and the other manufacturer provides these services direct from the factory. Finally, the pros and cons of delivery through the local dealer to the Government user were discussed. Two problems were identified; The dealer is unfamiliar with the Government Procurement System, and the dealer has no incentive to provide service unless he shares the profits of sale or of future sales. However, one manufacturer was in favor of delivery of tractors through his local dealers, since the manufacturer would be assured of proper pre-service before the tractor is put in service. This assurance of proper dealer preparation would eliminate many warranty problems which in the past have been traced to improper setup by the Government user.

a. The following warehouse tractors were depicted by the corresponding manufacturers in the TIPs submitted to MERADCOM: Clark, CT-40; Northwestern, J6-40-PT15; Pettibone, Huskie Model 40; and United Shop Mule SM-40. Photographs of these tractors are shown in Figures 2 through 5.

b. Table 1 was prepared from the data presented in each TIP to compare the various standard, optional, and non-standard features of each tractor and to compare each tractor to MIL-T-52852 for reference purposes. In general, the comparison verifies a pre-survey observation: Warehouse tractors purchased via MIL-T-52852 are not significantly different from commercial warehouse tractors. All of the requirements of MIL-T-52852 can be satisfied by either optional or available features from each manufacturer. Table 1 will be used to develop the rationale concerning which features should be specified in the "new" specification. One approach would be to specify only those desirable features not standard with all manufacturers. Front brakes, as an example, are not standard and should be specified in the new specification. This approach assumes the manufacturer would provide his standard model for the "new" specification.

c. Table 2 compares the technical/automotive characteristics of commercial tow tractors from the four manufacturers surveyed. Technically/automotively the tractors do not differ significantly from tow tractors previously procured using MIL-T-52852 except for certain features such as the absence of front brakes on the United tractor or the non-conformance of Pettibone's seat with SAE J899.

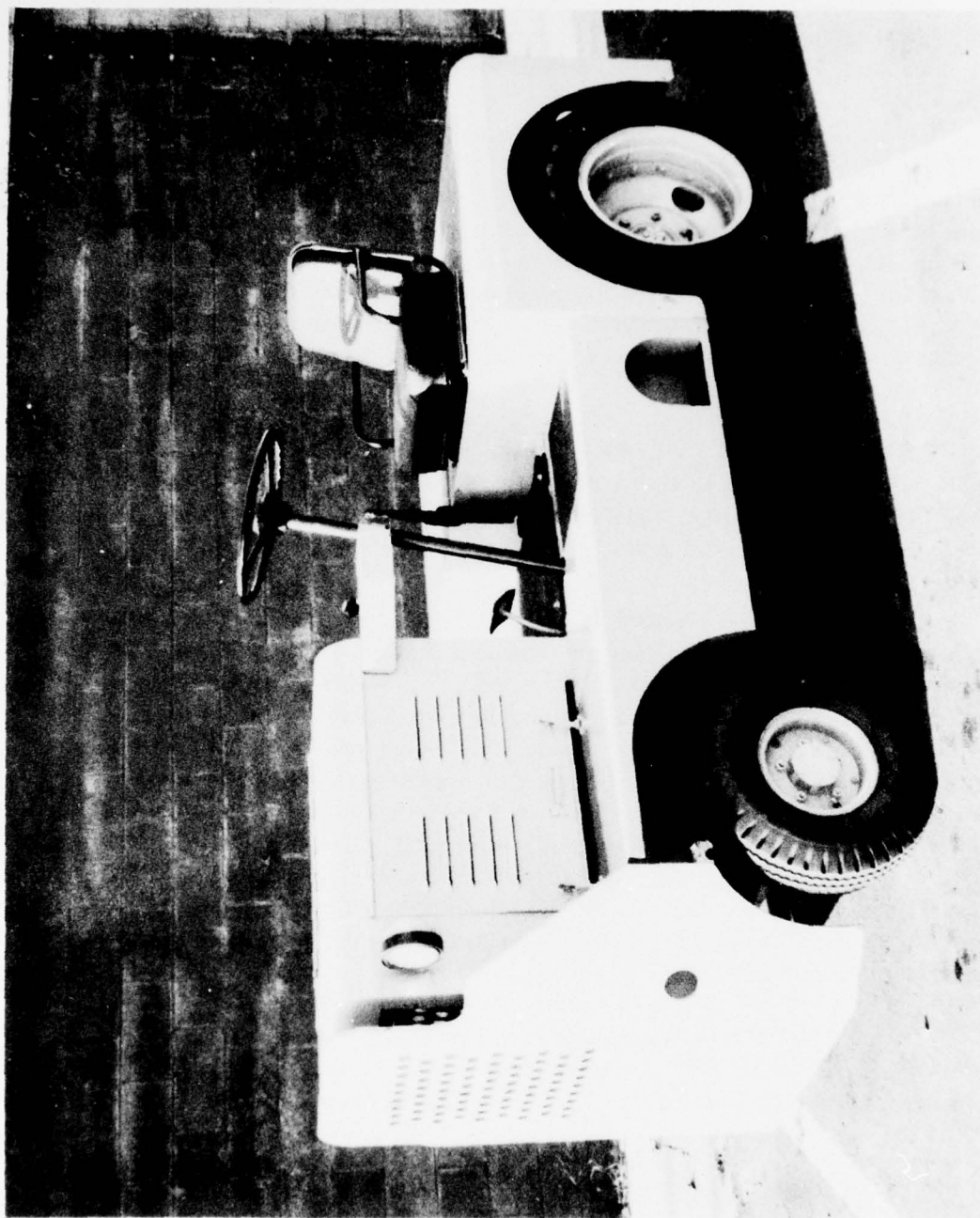


Figure 2. Northwestern J6-40-PT15 warehouse tractor.



Figure 3. United Shop Mule SM-40 warehouse tractor.



Figure 4. Clark CT-40 warehouse tractor.

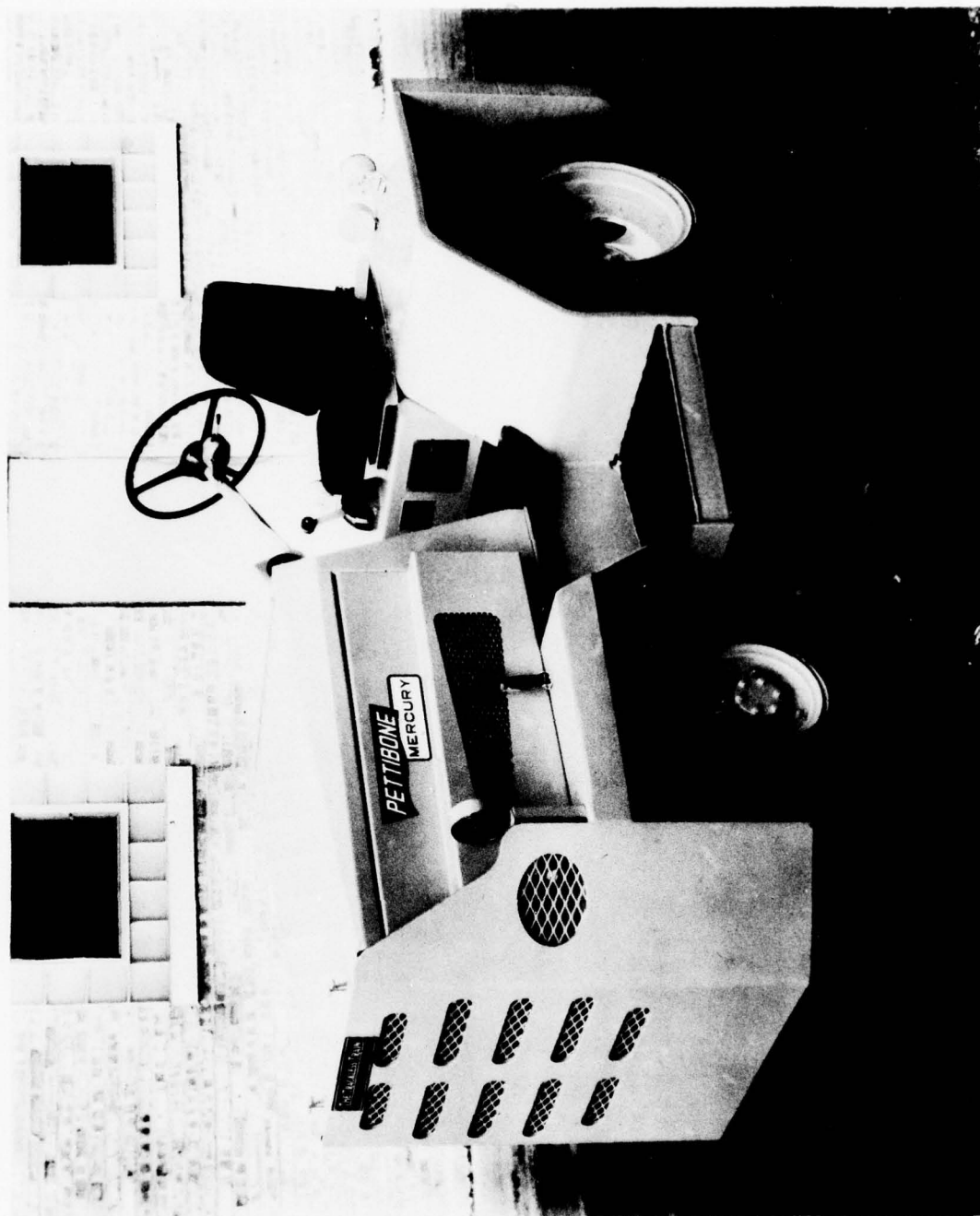


Figure 5. Pettibone Huskie Model 40 warehouse tractor.

Table 1. Comparison of Commercial Warehouse Tractors vs Existing Specifications

LEGEND: S = Standard, furnished. O = Optional. N = Not Standard, not furnished (may be option). SF = Special Feature (may be option).

Feature	Manufacturer				Requirement of MIL-T-52852 (Par. No.)
	Northwestern	United	Pettibone	Clark	
Gasoline Engine	S	S	S	S	1.1
LPG Engine	O	O	O	O	
Diesel Engine	O	O	O	O	
Crankcase Ventilation System	S	S	S	S	3.9.2.10
Pressurized Cooling System	S	S	S	S	3.9.2.5.4
Governed Engine Speed	S	S	S	S	3.9.2.6
Governor	S	S	S	S	3.9.2.6
Air Cleaner Restriction Indicator	S	SF	O	SF	3.9.2.4.2
Fuel Pump - ANSI B56.4	S	S	S	S	3.5
Fuel Filter	S	S	S	S	3.9.2.4
Carburetor - ANSI B56.4	S	S	S	S	3.5
Water Pump	S	S	S	S	3.9.2.5.2
Thermostat	S	S	S	S	3.9.2.5.3
Alternator	S	S	S	S	3.9.2.2
Full Flow Oil Filter	S	S	S	S	3.9.2.8
Battery - SAE J537	S	S	S	S	3.24.2
Battery Hold-Downs	S	N	S	S	3.24.4.1
Battery Inclosure Acid-Resistant	S	S	S	S	3.24.4.1
Alternator-Waterproofing	O	N	N	N	3.9.2.9
Alternator-Fungusproofing	O	N	S	N	3.9.2.9
Alternator Protection Rev. Polarity	O	N	O	N	3.9.2.2.1
Voltage Regulator	S	S	S	S	
Starter Motor-Fungusproofing	O	N	N	N	3.9.2.9
Fan-Viscous Drive	N	N	N	N	
Fuel Tank-ANSI B56.4	S	S	S	S	3.5
Lead-Free Gasoline	S	N	S	S	

Table 1. Comparison of Commercial Warehouse Tractors vs Existing Specifications (Cont'd)

Feature	Manufacturer			Requirement of MIL-T-52852 (Par. No.)
	Northwestern	United	Pettibone	Clark
Torque Converter	S	S	S	S
Automatic Transmission	S	S	S	S
Transmission Filter - Internal Screen	S	S	S	N
Front Axle - Suspension	S	S	S	S
Front Axle - 2 Tires	S	S	S	S
Rear Axle Suspension	S	N	S	S
Rear Axle - 2 Tires	S	N	S	S
Steering System - Manual/Power	S	S	S	S
Front Brakes	S	N	S	S
Front Brakes - Manual Adjustment	S	N	S	S
Front Brakes - Self-Adjusting	N	N	N	N
Front Brakes - Power-Assisted	N	N	S	S
Front Brakes - Hydraulic-Actuation	S	N	N	N
Rear Brakes	S	S	S	S
Rear Brakes - Manual Adjustment	S	S	N	S
Rear Brakes - Self-Adjusting	N	N	S	N
Rear Brakes - Power-Assisted	N	N	S	S
Rear Brakes - Hydraulic-Actuation	S	S	N	N
Parking Brake	S	S	S	S
Seat - SAE J899	S	S	N	S
Vehicle Noise Level - 85dB (A)	S	N	S	S
Alternator Indicator Light	N	O	O	SF
Ammeter	S	S	S	S
Voltmeter	N	SF	O	SF
Engine Hourmeter	S	S	S	S
Engine Oil Pressure Gauge	S	S	S	S
Engine Oil Low-Pressure Warning Light	N	O	O	SF
Engine Coolant Temperature Gauge	S	S	S	S
Engine Coolant High-Temperature Warning Light	N	O	O	SF
Transmission Oil Temperature Gauge	S	S	O	SF

Table 1. Comparison of Commercial Warehouse Tractors vs Existing Specifications (Cont'd)

Feature	Manufacturer				Requirement of MIL-T-52852 (Par. No.)
	Northwestern	United	Pettibone	Clark	
Transmission Oil High-Temperature Warning Light	N	O	O	SF	3.23.11.
Fuel Gauge	S	S	S	S	3.23.13
Air Cleaner Restriction Indicator	S	SF	O	SF	3.9.2.4.2
Key Ignition Switch	S	S	S	S	3.2.3.3
12-Volt Electrical System	S	S	S	S	3.24.4
Instrument Panel Lights	S	O	O	SF	
Individual Light Switches	N	O	O	S	
Directional Signals	O	O	O	SF	
Flashing Warning Lights	O	O	O	SF	
Front Travel Lights — Two	S	S	O	S	3.24.1
Front Flood Lights	N	O	O	SF	
Rear Backup Light — One	S	O	O	S	3.24.3
Electrical Circuit Breakers	N	O	O	SF	3.24
Electrical Fuses	S	S	S	S	3.24
Radiator Guard	S	S	S	S	3.9.2.5.4
Spark-Arresting Muffler	S	S	O	SF	3.5
Seat Belt	O	O	O	SF	
Horn	S	S	S	S	3.24.5
Protecto Seal Fuel Filter	S	S	S	S	3.9.2.4
Fire Extinguisher	O	O	O	SF	
Closed Cab	O	O	O	O	3.21
Neutral-Start Protective Switch	S	S	S	S	3.9.2.3
Starter Protective Switch — After Engine Start	S	O	S	S	3.9.2.3
Spring-Counterbalanced Hood	S	O	N	S	3.19
Positive Hood Hold-Open Device	O	S	S	SF	3.19
Windshield Wipers — Two	O	O	O	O	3.21
Cab Heater	O	O	O	O	3.21
Cab Defroster	O	O	O	O	3.21
Noise Control Provisions	N	O	O	N	
Screw Threads — NBS H28	S	S	S	S	3.7.3

Table 1. Comparison of Commercial Warehouse Tractors vs Existing Specifications (Cont'd)

Feature	Manufacturer			Requirement of MIL-T-52852 (Par. No.)	
	Northwestern	United	Pettibone	Clark	
Lubrication Fittings - SAE J534	S	S	S	S	3.7.2.2
Engine/Transmission Elastomer Shock Mounts	S	S	S	S	3.10.4
Identification/Warning Plates	S	S	S	S	3.28
Color End Item - Yellow	S	S	S	S	3.26
Non-Slip Walkway Coating	S	S	S	SF	3.26.1
Warranty Furnished	S	S	S	S	
Operator's Manual Furnished	S	S	S	S	
Maintenance Manual Furnished	S	S	S	S	
Rebuild Manual Furnished	S	S	N	O	
Repair Parts Manual Furnished	S	S	S	S	
Lubrication Instructions Furnished	S	S	S	S	
Training Aids Furnished	N	N	N	O	
Revisions to Manuals After Issue	S	S	S	N	3.22
Tiedown Provisions Provided	S	S	N	N	3.22
Lifting Provisions Provided	S	S	N	N	3.9.2.1
Choke - Automatic or Manual	S	S	S	S	3.23.7
Transmission Control - Right-Hand Operation	S	S	S	S	3.2.5.3
Speed (FWD) - 12 mi/h/min	S	S	S	S	3.2.5.3
Speed (REV) - NLT 5 mi/h	S	S	S	S	3.27
EMI - SAE J551a	*	*	S	*	3.12
Coupler	S	S	S	S	
Operate for 6 hours w/o refilling fuel	S	S	S	S	
4 Wheel Brakes	S	N	S	S	3.16.1

* Question not asked on questionnaire before being revised.

Table 2. Comparison of Technical/Automotive Characteristics of Four Commercial Warehouse Tractors

Specifications	Engine and Engine Accessories				Clark Model CT-40
	Northwestern Model J6-40PT15	United Model Shop Mule SM-40	Pettibone Model Huskie Model 40		
Engine manufacturer	Chrysler	Chrysler	Ford Motor Co.		Ford Motor Co.
Number of cylinders	6	6	6		6
Bore (in.)	3.41	3.4	4.00		4.00
Stroke (in.)	4.12	4.125	3.98		3.98
Total displacement (in. ³)	225	225	300		300
Compression ratio	8.2:1	8.4:1	8.4:1		7.9:1
Gross horsepower @ r/min	Not stated	132 @ 4000	149 @ 2800		132 @ 3600
Intermittent horsepower @ r/min	95 @ 3600	100 @ 3600	119 @ 2800		132 @ 3600
Continuous horsepower @ r/min	70 @ 3200	79 @ 3200	101 @ 2800		102.5 @ 2800
Max. governed horsepower @ r/min	95 @ 2500	105 @ 2800	115 @ 2650		86 @ 2600
Net horsepower @ r/min	120 @ 4000	120 @ 4000	115 @ 2650		Not stated
Max. torque (lb/ft) @ r/min	195 @ 2000	196 @ 1200	249 @ 1600		241 @ 1800
Engine conform to Calif. Title B	Not stated	No	No		No
Governed engine speed (no-load) at r/min	2400	2800	2600-2650		2650
Governor manufacturer	Chrysler	Chrysler	Ford Motor Co.		Ford Motor Co.
Air cleaner manufacturer	Chrysler	Chrysler	Ford Motor Co.		Donalson
Restriction indicator	No	No	No		No
Mounting location	N/A	N/A	N/A		N/A
Type of hose clamps	Not stated	Not stated	Worm gear-band type		Adj. Strap
Fuel pump manufacturer	Chrysler	Chrysler	Ford Motor Co.		Ford Motor Co.
Conform to ANSI B56.4	Yes	Yes	Yes		Not stated
Fuel filter manufacturer	Chrysler	Chrysler	Ford Motor Co.		Ford Motor Co.
Location	In fuel line	In fuel line	Part of eng. fuel pump		Top of pump
Carburetor manufacturer	Chrysler	Cartet	Ford Motor Co.		Ford Motor Co.
Type	Downdraft	Downdraft	Downdraft		Downdraft
Conform to ANSI B56.4	Yes	Yes	Yes		Yes
Choke actuation	Manual	Automatic	Manual		Manual
Crankcase ventilation system manufacturer	Chrysler	Chrysler	Ford Motor Co.		Ford Motor Co.
Type	Positive	Vent. valve filament	Positive		Positive
Spark plugs manufacturer	Champion	Champion	Ford Motor Co.		Autolite
Ignition wires manufacturer	Chrysler	Chrysler	Ford Motor Co.		Ford Motor Co.
Resistance/foot (rated)	Not stated	Not stated	50 ohms		Not stated
Distributor manufacturer	Chrysler	Chrysler	Ford Motor Co.		Ford Motor Co.

Table 2. Comparison of Technical/Automotive Characteristics of Four Commercial Warehouse Tractors (Cont'd)

Specifications	Northwestern Model J6-40PT15	United Model Shop Mule SM-40	Pettibone Model Huskie Model 40	Clark Model CT-40
Type	Electronic	Centrifugal	Breaker PT-Condenser	Contact Point
Ignition coil manufacturer	Chrysler	Chrysler	Ford Motor Co.	Ford Motor Co.
Muffler manufacturer	Nelson	Nelson	Nelson	Nelson
Type	Baffled-single pass	Spark-arresting		Tuned multi-pass
Conform to ANSI B56.4	Yes	Yes	Yes	Yes
Cooling system	Liquid pressurized	Liquid pressurized	Liquid pressurized	Liquid pressurized
Capacity (US gal)	3.25	5.5	4.5	3.75
Pressure (operating) (lb/in ²)	14	7	7	7
Type of antifreeze furnished	Ethylene glycol	Ethylene glycol	Ethylene glycol	Ethylene glycol
Radiator manufacturer	Chrysler	Young	Southern Radiator Co.	McCord (Young)
Capacity (qt)	13	14.5	16	16
Radiator construction	Fin & tube, vertical flow	Fin & tube	Fin & tube	Fin & tube
Number of fins/inch	Not stated	Not stated	11	9
Number of tubes	Not stated	Not stated	130	Not stated
Core length (in.)	Not stated	21-15/16	19	23
Core width (in.)	Not stated	19-3/8	21	19 3/4
Core thickness (in.)	Not stated	2-1/4	2-13/16	3
Water pump manufacturer	Chrysler	Chrysler	Ford Motor Co.	Ford Motor Co.
Thermostat manufacturer	Chrysler	Chrysler	Ford Motor Co.	Ford Motor Co.
Temp range (open & closed) °F	180 full open	160-180	212 full open	178-202
Fan belt manufacturer	Chrysler	Chrysler	Ford Motor Co.	Ford Motor Co.
Generator or alternator belt manufacturer	Chrysler	Chrysler	Ford Motor Co.	Ford Motor Co.
Engine lub. system-type cyl. lub.	Squirt & splash	Oil pump	Pressure	Sub. rotor pump
Type main bearing lub.	Pressure	Oil bath	Full pressure	Oil bath
Operating lb/in ² @ idle/max. rated speed	8/30-70	50/	40/60	35/60
Capacity (qt)	5	6	6	6
Oil filter manufacturer	Chrysler	Chrysler	Ford Motor Co.	Ford Motor Co.
Type	Full flow	Full flow	Full flow	Full flow
Filtration range — micron	Not stated	Not stated	Not stated	Not stated
Battery manufacturer	Gould	General	Exide	Prestolite
Type	12-volt wet & chgd.	12-volt wet	12-volt	12-volt
Ground (positive or negative)	Negative	Negative	Negative	Negative
Battery capacity	60-amp	85-amp	70-amp	72-amp hr
Conform to SAE J537	Yes	No	Yes	Yes

Table 2. Comparison of Technical/Automotive Characteristics of Four Commercial Warehouse Tractors (Cont'd)

Specifications	Northwestern Model J6-40PT15	United Model Shop Mule SM-40	Pettibone Model Huskie Model 40	Clark Model CT-40
Hold-downs furnished	Yes	Yes	Yes	Yes
Hold-downs acid resistant	Yes	Yes	Yes	No
Alternator manufacturer	Motorola	Chrysler	Ford Motor Co.	Delco
Type	Not stated	Not stated	Pulley-driven	106
Rated output — amps @ r/min	37	41	15-v — 40 @ 2000	37 @ 6500
Ground (positive or negative)	Negative	Negative	Negative	Negative
Waterproofing	No	No	No	No
Fungusproofing	No	No	Yes	No
Protection against reverse polarity	No	No	No	No
r/min @ engine no-load governed speed	Not stated	Not stated	5500	6500
Voltage regulator manufacturer	Motorola	Chrysler	Ford Motor Co.	Delco
Location (integral or separate)	Integral	Separate	Separate	Integral
Starter motor manufacturer	Chrysler	Chrysler	Ford Motor Co.	Delco
Fan manufacturer	Chrysler	Chrysler	Ford Motor Co.	Ford Motor Co.
Type (suction; blower)	Suction	Suction	Suction	Suction
Diameter/Number of blades/pitch	18/7/3/4	17/3/Not stated	17/5/Not stated	18/5/Not stated
Viscous drive	No	No	No	No
Fuel tank manufacturer	Northwestern	United tractor	Pettibone	Clark
Capacity (US gal)	14	13	20	17
Conform to ANSI B56.4	Yes	Yes	Yes	Yes
Equipped with shut-off valve	Yes	Yes	Elec solenoid lockoff	Yes
Engine operate on lead-free gasoline	Yes	No — low lead	Yes	Yes
Fuel consumption/hour (US gal)	1.325	Not stated	Not stated	Not stated
Specifications, Power Train				
Torque converter manufacturer	Chrysler	Chrysler	Ford Motor Co.	Ford Motor Co.
Size (in.)	10 1/2	10 3/4	12	Not stated
Max. input torque — (lb/ft) @ r/min	380 @ 2400	Not stated	250 @ 3500	Not stated
Input torque rating (lb/ft) @ r/min	380 @ 2400	Not stated	250 @ 3500	154 @ 1660
Max. stall torque rated	2.0:1	1.86:1	2.1	1.12:1
Torque converter stall speed — r/min	1740	Not stated	2140	1246
Eng. vac. at torque conv. stall speed — in. hg.	10 1/2	Not stated	Not stated	Not stated
Oil type	A	A	A	F

Table 2. Comparison of Technical/Automotive Characteristics of Four Commercial Warehouse Tractors (Cont'd)

Specifications	Northwestern Model J6-40PT15	United Model Shop Mule SM-40	Pertibone Model Huskie Model 40	Clark Model CT-40
Oil capacity (US qt)	Not stated	Not stated	Not stated	5.5
Transmission manufacturer	Chrysler	Chrysler	Ford Motor Co.	Ford Motor Co.
Type	Auto.	Auto.	Auto.	Auto.
No. of speeds forward -- reverse	3-1	3-1	3-1	2-1
Oil capacity (qt)	4.875	9 qt 16 oz.	4	5.5
Oil type	A	A	A	F
Type oil cooling	Radiator liquid	Radiator/tube & fin	Trans. mtd. radiator cooled	Radiator lower tank
Transmission inching provided	No	No	No	No
Transmission disconnect provided	No	No	No	No
Gear ratios speed (mi/h)				
First	2.45-6.6	2.45:1-5.35	2.4-6.2	Blocked out
Reverse	2.2-7.0	2.20:1-5.96	2.0-7.6	2.00-6.5
Second	1.45-11.2	1.45:1-9.04	1.47-10.2	1.47-8.9
Third	1.1-15.0	1.00:1-13.10	1.0-15.2	1.00-13
Input torque rating (lb/ft) @ r/min	195 @ 2000	Not stated	400 @ 3600	Not stated
Filter element manufacturer	Chrysler full flow	Chrysler	None	Not stated
Physical location	Bottom of sump	Valve body assy.	N/A	Not stated
Filtration range -- microns	Not stated	Not stated	Not stated	Not stated
Drive or propeller shafts manufacturer	Mechanics universal	Mechanics universal	Mechanics universal	Spicer
Type (ref. SAE J901)	2-joint in-board	Not stated	Cardan	Cardan
Universal joints (No. & type)	2-joint Cardan	114-3100 3CL (type)	1-slip-type	1410
Torque capacity (lb/ft)	1950	1950	2445	250
Front axle manufacturer	Rockwell Std.	Rockwell Std.	Rockwell Std.	Clark
Driven	No	No	No	No
Type (drive-axle only)	N/A	N/A	N/A	N/A
Capacity rating: torque	None	Not stated	None	Not stated
Beam load (lb)	3600	Not stated	2200	2500
Type of suspension	Leaf spring	Leaf spring	Leaf spring	Leaf spring
Rear axle manufacturer	Rockwell Std.	Rockwell Std.	Rockwell Std.	Clark
Driven	Yes	Yes	Yes	Yes
Type (drive-axle only)	Semi-floating	Not stated	Diff. carrier, drop box (SAE J923)	Full floating
Gear reduction ratio	14.14:1	17:1	14.14:1	17.311:1

Table 2. Comparison of Technical/Automotive Characteristics of Four Commercial Warehouse Tractors (Cont'd)

Specifications	Northwestern Model J6-40PT15	United Model Shop Mule SM-40	Pettibone Model Huskie Model 40	Clark Model CT-40
Torque (lb ft)	Not stated	Not stated	525	6750
Beam load (lb)	Not stated	Not stated	4000	10,000
Type of suspension	Leaf spring	Spring-cushion pads	Leaf spring	Leaf spring
Front wheels manufacturer	DICO	Electric wheel	Geneva wheel	Rudd
Rim type	Drop center	Double disc	Split-S.D.C.	Disc halves
Tire size & ply ratings	8.00 x 10 4-ply 2	6.00 x 10 6-ply 2	6.00 x 9 6-ply 2	6.50 x 10 6-ply 2
No. of tires per axle	2	2	2	2
Wheel loading (lb)	840	800	1000	950
Wheel loading w/rated load (lb)	840	387	900	500
Rear wheels manufacturer	Northwestern	Budd	Budd wheel	Budd
Rim type	Drop center	Rim w/side ring	Goodyear L1S	2-pc conv. rim drop cen.
Rim size	6.00 x 16.5	5.50 x 16	5.50 x 16	16. x 5.50 F 6-hole
Tire size & ply rating	8.0 x 16.5 6-ply 2	6.50 x 16 6-ply 4	7.00 x 16 6-ply 2	6.50 x 10 6-ply 2
No. of tires per axle	2	2	2	2
Wheel loading (lb)	1725	838	1880	1950
Wheel loading w/rated load (lb)	1725	1044	1980	2268
Specifications, Steering & Brakes				
Steering system type	Manual	Manual	Manual	Manual
Steering control unit manufacturer	Saginaw	Ross	Ross	Saginaw
Power steering pump supplied	N/A	N/A	N/A	N/A
Pump manufacturer	N/A	N/A	N/A	N/A
Max. system pressure	N/A	N/A	N/A	N/A
Steering wheel dia (in.)	18	18	17	18
No. of turns lock-to-lock	5	5½	5-2/3	5.3
Braking system manufacturer	Rockwell	Rockwell	Rockwell	Bendix
Front brakes	Drum	None	Drum	Drum
Lining	Bonded	None	Bonded (28 in. ²)	Bonded
L x W x T (in.)	Not stated	None	4 x 1¾ x 3/16	8 x 1.75 x Not stated

Table 2. Comparison of Technical/Automotive Characteristics of Four Commercial Warehouse Tractors (Cont'd)

Specifications	Northwestern Model J640PT15	United Model Shop Mule SM-40	Pettibone Model Huskie Model 40	Clark Model CT-40
Drum diameter (in.)	8	None	8	8
Type brake adjustment	Manual	None	Manual	Manual
Power assisted	No	None	Yes	Yes
Method of actuation	Hydraulic	None	Vacuum	Vacuum
Rear brakes	Drum	Drum	Drum	Drum
Lining	Bonded	Bonded	Bonded (63 in. ²)	Bonded
L x W x T (in.)	Not stated	14 x 2 1/4 x 1/4	28 x 2 1/4 x 1/4	14 x 2 x Not stated
Drum dia (in.)	12 1/4	12 1/2	12 1/4	14
Type brake adjustment	Manual	Manual	Self-adjusting	Manual
Power assisted	No	No	Yes	Yes
Method of actuation	Hydraulic	Hydraulic	Vacuum	Vacuum
Master brake valve manufacturer	Bendix	Wagner	Bendix	Bendix (dual split System)
Parking brake manufacturer	Chrysler	Chrysler	Ford Motor Co.	Orschelin
Type	Shoe	Shoe	Shoe	Friction band
Type of actuation	Lever	Lever	Lever Orschelin	Lever
Equipped with locking device	Yes	Yes	Yes	Yes
Location of brake	Transmission	Transmission	Transmission	Transmission
Specifications, Operator's Compartment				
Directional control				
Actuation	Right hand	Right hand	Right hand	Right hand
Location	Dash board	Beside driver	Beside driver	Beside driver
Position markings	Yes	Yes	Yes	Yes
Type	Embedded markings	Embossed	Metal decal	Screen decal
Seat				
Seat conform to SAE J899	Yes	Yes	No	Yes
Seat covered with vinyl or similar	Yes	Yes	Yes	Yes
Dimensions				
Distance between steering wheel and seat (in.)	10 3/4	11	8 3/4	7.0
Height of seat above floor (in.)	16	18	16	17.62
Height of floor above ground (in.)	26-14 3/4	25	26-14	24.75
Distance between seat & parking brake (in.)	1	8	6	14.0

Table 2. Comparison of Technical/Automotive Characteristics of Four Commercial Warehouse Tractors (Cont'd)

Specifications	Northwestern Model Jo-40PT15	United Model Shop Mule SM-40	Pettibone Model Huskie Model 40	Clark Model CT-40
Distance between accel. & brake pedal (in.)	3	3 3/4	4	2.5
Dimensions of brake pedal (in.)	3 1/2 W x 2 1/2 H	3 in. dia.	3 1/2 W x 2 1/2 H	3 x 3
Location of pintle hook actuator	Rt. of opr. seat	On pintle hook	On rear counterweight	Rt. of opr. seat
Specifications, Dimensional				
Overall length (in.)	101.5	99	101	102
Overall width (in.)	57	59	55	55.5
Overall height w/o cab (in.)	60	59	65	62.0
Wheel base (in.)	65	58	56.5	57.5
Drive tire tread width (C to C) (in.)	48	57.7	46	46.94
Steer tire tread width (C to C) (in.)	48	47	40.5	44.75
Clearance of drive tires to body (in.)	3	4.2	5	2.5
Minimum ground clearance (in.)	6	8.7	5.5	7.0
Height of exhaust outlet (in.)	9.75	9.5	10	7.25
Thickness of front bumper plate (in.)	0.5	0.5	0.5	0.5
Thickness of rear bumper plate (in.)	0.5	0.5	3	0.5
Pintle hook height/vert. adj. (in.)	12/2	12/0	12/0	12/16
Gross vehicle weight (lb)	5300	5350	5450	6400
Ultimate DBP (lb)	4000	4000	4000	4000
Vehicle clearance circle (ft)	19.8	18.83	19.0	19.18
Travel speed -- fwd (mi/h)	15.0	13.0	15.0	13.0
rev (mi/h)	7.0	6.5	7.5	6.5
Vehicle noise levels				
No load gov. eng. speed (dB(A))	82	95	82	85
At 4000 lb DBP (dB(A))	Not stated	72	Not stated	73

d. Each manufacturer complied with the request to list industrial users of the tow tractor described in the TIP. These users will be surveyed in a subsequent phase of this program.

IV. CONCLUSIONS

10. Conclusions. It is concluded that:

a. Commercial warehouse tractors do not differ significantly from warehouse tractors previously procured by the Army using MIL-T-52852.

b. The following makes and models of commercial warehouse tractors will be offered by the manufacturers to meet the Government's new specification: Clark CT-40, Northwestern J6-40-PT15, Pettibone Huskie Model 40, and United Shop Mule SM-40.

c. Industrial users of the candidate makes/models of commercial warehouse tractors were identified.

APPENDIX

ITEM DESCRIPTION FOR TRACTOR, WHEELED, WAREHOUSE, GASOLINE, 4000-POUND-DRAWBAR-PULL, PNEUMATIC-TIRED

1. Scope. This description covers a commercial model warehouse tractor equipped with a gasoline engine; automatic transmission; two single, non-driving, steerable front wheels; two single, driving, non-steerable rear wheels; pneumatic tires; four-wheel-sprung suspension; and four-wheel-split-brake system. The warehouse tractor shall be the latest model of the standard commercial product of the supplier and shall have been in production, marketed, and in use in significant quantities by commercial or Federal Government users for a minimum of 1 year prior to the Step I technical proposal opening date. The introduction of normal product improvement changes in this 1-year period is acceptable.

2. Requirements.

2.1 General. The warehouse tractor shall be equipped with standard instruments, components, and accessories normally required for the safe and effective operation of the tractor. The tractor shall be complete with all components that are standard with the supplier's products, whether stipulated herein or not, together with such accessories as may be specified herein. The tractor shall be equipped with all other components and parts not specifically mentioned but necessary to provide a functional machine and shall conform in quality to that normally provided to the commercial industry.

2.2 Operating Temperature. The tractor shall start without preheating and shall be designed for operation in any ambient from 0°F to plus 110°F.

2.3 Safety. The tractor shall conform to the requirements of ANSI B56.4, Type G.

2.4 Drawbar Pull. The tractor shall be capable of developing a towing force of not less than 4000 lb at a 12 plus or minus ½-inch coupler height on a level, clean, brushed, concrete surface.

2.5 Speed. The tractor, without trailing load, shall be capable of attaining a minimum of 12 miles per hour speed in high gear on a level surface.

2.6 Coupler. The tractor shall be equipped with a semi-automatic pintle-type coupler. The coupler shall consist of a coupler jaw configuration with a minimum throat opening of $1\frac{1}{4}$ inches and a minimum throat length of $5\frac{1}{4}$ inches and an accompanying spring-loaded latch and pin.

2.7 Instruments. The tractor shall be furnished with the following instruments:

- a. Hour meter.
- b. Ammeter, voltmeter, or red alternator indicator light.
- c. Fuel gauge.
- d. Engine oil pressure gauge or warning light.
- e. Engine coolant temperature gauge or warning light.

2.8 Lights. The tractor shall be furnished with the following lights:

- a. Two sealed-beam-type headlights.
- b. One automotive, red, reflector-type, combination stop- and tail-light.
- c. Backup light.

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